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IDENTIFIERS	Northampton County Area Community College PA; Programable Logic Control

ABSTRACT

This document contains needs assessments used by Northampton Community College to develop training courses for a business-industry technology resource center for firms in eastern Pennsylvania. The following needs assessments are included: (1) individual skills survey for workers at Keystone Cement Company; (2) Keystone group skills survey; (3) management interview for Keystone; (4) Keystone technical staff interview; (5) Keystone maintenance/production supervisors interview; (6) Keystone maintenance workers interview; (7) individual worker skills and needs survey developed for Tarkett, Inc.; and (8) mathematics skills assessment for machine tool operators at Dent Manufacturing. (KC)

NEEDS ASSESSMENTS FOR AUTOMATED MANUFACTURING TRAINING PROGRAMS

Center for Business & Industry
Northampton Community College
3835 Green Pond Road
Bethlehem, PA 18017

KEYSTONE CEMENT CO.
NEEDS
ASSESSMENT

Topic: Controls Training for
Maintenance Personnel

Keystone Skills Survey

Position _____

Next to each skill listed, please check under the appropriate column whether the skill is needed to do their job adequately and whether you have the necessary level of skill. Under the 3rd column please indicate what percent of maintenance/production workers you think have the necessary skill level.

	Is this skill needed in your current job?	Do you have this skill?	What % of maint./prod workers have skill?
Basic electrical	_____	_____	_____
Advanced electrical	_____	_____	_____
Basic electronics	_____	_____	_____
Advanced electronics	_____	_____	_____
Programmable controls	_____	_____	_____
Machining	_____	_____	_____
Basic welding	_____	_____	_____
Advanced welding	_____	_____	_____
Blueprint reading	_____	_____	_____
Schematic interpretation	_____	_____	_____
Pipe fitting	_____	_____	_____
Hydraulics	_____	_____	_____
Pneumatics	_____	_____	_____
HVAC	_____	_____	_____
Troubleshooting Electrical	_____	_____	_____
Troubleshooting Mechanical	_____	_____	_____

Knowledge of Basic Controls	_____	_____	_____
Knowledge of Automatic Control Systems	_____	_____	_____
Knowledge of Automated Manufacturing	_____	_____	_____

Basic Skill Level

Next to each basic skill listed, please check under the appropriate column whether you think you need help in improving your skill level and what percent of maintenance workers you think might need that help.

	Do you need help in this skill area?	What % of maint./ production workers need help in this skills area?
Basic math (calculations, decimals, fractions, percentages)	_____	_____
Advanced math (algebra)	_____	_____
Measurement	_____	_____
Reading	_____	_____
Writing	_____	_____

If you need help in the basic skills, would you be willing to participate in classes?

_____

What percent of those who need help do you think would be willing to participate in classes?

_____

How long have you worked at Keystone?

_____

What is the highest level of education you have completed?

_____

Specialized training/courses taken:

_____

GROUP SKILLS SURVEY

Please indicate familiarity of electrical maintenance personnel with the following content. Indicate YES if personnel have this skill and NO if they do not.

Programmable logic controllers? Applications, capabilities, operation, programming?

YES NO

Control components? Sensors, actuators, processors, motors, reading basic control circuit diagrams? Pneumatic, hydraulic, and electrical controls? Numbering systems--binary and hexadecimal?

YES NO

Industrial electricity? Electrical power, wiring & control? DC and AC generators and motors, transformers, electrical distribution, ground fault, overcurrent protection, industrial wiring methods and codes. and the proper use of meters in the high voltage setting?

YES NO

Motor controls? Installation, operation & troubleshooting of various types of motor controls? Motor starting methods, control pilot devices, diagram interpretation, basic control circuits, AC reduced voltage starters, 3-phase, multispeed, DC controllers and methods of deceleration?

YES NO

Basic electricity--Fundamentals of electricity, electrical safety, basic switching circuits, meter usage, basics of Ohm's Law, Watt's Law and simple series and parallel circuits?

YES NO

Basic electricity--Color code, DC and AC theory, Ohm's Law and Watt's Law in resistive series/parallel combination circuits, magnetism, inductance, electromagnetism and capacitance? Soldering?

YES NO

Basic electronics? DC and AC operation of industrial electronic circuits. Basic applications of resistive, capacitive and inductive networks. Electromagnetic induction, reactance and resonance. Analysis of circuits using Ohm's Law (review) and Kirchoff's Law. Operation of PLC circuits.

YES NO

Advanced electronics? Broad understanding of direct and alternating current circuits and components. The fundamentals of solid state devices such as transistors, diodes, rectifiers, SCR's triacs, FETs, and unijunctions, their biasing and circuit applications. Topics in digital electronics including binary numbers, gates, combinations of gates to form logical functions, and digital integrated circuits.

YES NO

Management Interview

Introductions
NCC/CBI background information
Keystone needs assessment/training
Purpose of meeting/interview

We will ask questions to gather background information about the company, its relationship with the parent, and current business goals. [to assist us in placing the current project in context, understand the long term plans for controls at Keystone, and make the best recommendation possible for personnel training.]

Structure of interview

GENERAL--KEYSTONE & LONG RANGE CONTROLS STRATEGY
What is relationship with parent company? What is the current organization (refer to chart)? Which people are at the Bath facility? Is marketing at Bath? What level of decision making authority/responsibility exists at Keystone? Tactical/operational level? Strategic planning? Capital investments?

What are the current business goals of the Keystone operation? -- Business positioning, new production direction, cost cutting, labor reduction...

What are the long range plans for Keystone?

What are the long range plans for controls at Keystone? Probe for controls strategy and fit within long range plans. Probe expected magnitude of investment, commitment/final decisionmaking, and variables impacting investment.

Describe the technical expertise at Keystone. What are the personnel strengths & weaknesses? (from your perspective)

Describe future organizational direction, personnel changes, changes in technical or management structure.

SPECIFIC--IMMEDIATE PROJECT GOALS AND IMPLEMENTATION
What are the goals of the clinker storage system? --efficiency, quality, cost reduction (reduced labor)? What is the ROI for the project?

What expectations do you have regarding project implementation? Describe project phases. Probe perceived critical success factors, project hurdles, integration into Keystone operations.

Who is on the project team? Is their a project engineer assigned to coordinate Keystone activities?

What is the expected involvement of Keystone personnel? Who is installing the system? Who will support and maintain the system after startup? Longterm, who will plan future phases of controls implementation? Probe technical strength and ability to design (or specify design parameters to a vendor) future controls, integrating them with resident controls.

What level of training is required to bring the current staff to the necessary level of expertise? [There may be technical expertise within Giant--explore availability if appropriate.]

Are there barriers to training amongst salaried personnel?

SPECIFIC--SKILLS OF MAINTENANCE AND PRODUCTION PERSONNEL
Existing Operations
In your existing operation, what expectations do you have of maintenance workers? Operators?

Are maintenance workers meeting those expectations? Operators?

What skills do they have? What level of competence do they have?

Do the maintenance workers/operators serve the entire operation or a particular area? Do they have broad skills or a particular area of expertise?

Are additional skills required? Are there areas you perceive require more training?

Do you perceive that there may be a need for basic skills training? Probe potential need for training in basic math skills, measurement, blueprint reading, industrial electricity..

(In existing operations) Is it your perception that your priorities for maintenance personnel/operators are the same as those of their supervisors and maintenance personnel/operators themselves? (Probe here a bit George's interest in basic training for his people.)

If they differ, why do you think that is?

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Training w/ installation

New Clinker Storage System
Are there barriers to the acceptance of the clinker storage system?

Amongst supervisors?

Amongst hourly personnel?

Does the union fully support all aspects of the project? What is the union response to personnel acquiring new skills for new job responsibilities?

How would you gauge personnel response to automation and technology? Probe fears.

Are there barriers to training amongst hourly personnel?

What are the union issues relative to training? Is the union supportive of training? Are there guidelines/restrictions we should be aware of? Length of training? Who gets trained? Incentive systems?

What kinds of training have personnel (all levels) been involved in in the past? Formal? Informal? On-site? Off-site?

ASSESSMENT KEYSTONE NEEDS / SPECIFICS NCC ASSESSMENT
What type of training support are you looking for from us?

Personnel? Scope? Plantwide to educate all personnel potentially impacted now and in the future?

Management awareness, controls strategy, cost justification?

PLC programming, operation, and troubleshooting?

Technology implementation/supervisory & qc issues?

Customized training on Keystone PLC application?

On-site? Off-site? On-hours? Off-hours?

What type of additional support will you need to implement this and other automation projects? Just training or other technical assistance for project implementation?

INFO ON NEEDS ASSESSMENT PLAN
Review agenda. Discuss survey and interviews.
Plan reviewed with George & Ron.

We plan to conduct similar interviews with K. Wentzel's group, supervisors, and maintenance and production personnel. We will probe deeper into current plant operations/practices and work to further identify needs. Specific interview questions to be asked hourly workers reviewed with George & Ron.

(Probing here management comfort level with approach.)

keyques/1/43

Technical Staff Interview

Introductions - name, position

NCC/CBI background information
Keystone needs assessment/training
Purpose of meeting/interview
Structure of interview
Tape record interview

Describe the primary function of the laboratory group at Keystone.

Identify individual roles/job responsibilities.

What are the long range plans for the laboratory group?
Probe targeted activities for the group and identify projected changes in personnel / expansion of technical capability.

What is the involvement of the laboratory group in development of the overall control strategy for the plant?

In the development of the clinker storage system?

(If appropriate)
What are the long range plans for controls at Keystone?

What are the goals of the clinker storage system?

Will the control systems proposed immediately and longterm improve the overall quality of the products? Will they impact new product development?

Are there other process controls which could be included in future projects? How might these impact laboratory operations?

Describe the technical expertise at Keystone. What are the personnel strengths and weaknesses?

What do you perceive to be management's expectations regarding implementation of the controls project? What is the expected involvement of Keystone personnel in the installation and maintenance of the clinker storage system?

What level of training is required to bring the current staff (salaried/hourly) to the necessary level of expertise?

Training w/ installation ?

What is the skill level of the personnel in the lab group? Does anyone have experience and training in controls? Are there other training needs (for the lab group) which should be addressed?

In existing operations, what is the skill level of maintenance workers and operators? Are there areas you perceive require training?

Do you perceive there may be a need for basic skills training?

For the controls project, what type of skills training for maintenance and production personnel do you perceive to be of greatest need?

Are there barriers to the acceptance of the clinker storage system? Amongst supervisory personnel? Amongst hourly employees?

Are there barriers to training? Amongst supervisory personnel? Amongst hourly employees?

What type of support would you like to see at Keystone to assist with the implementation of the clinker storage system and other automation projects?

What type of assistance would be of greatest benefit to the lab group?

keyques2/l/lotus 17

Maintenance/[Production] Supervisors
*Note: Items in normal print for production supervisors' interview only.

Introductions - name, position

NCC/CBI background information
Keystone needs assessment/training
Purpose of meeting/interview
Structure of interview
Tape record interview

Describe the primary function of the maintenance [production] **group at Keystone.**

Identify individual roles/job responsibilities.

What are the goals of the clinker storage system?

What are your expectations regarding implementation of the clinker storage system project and future controls projects? What do you expect will be the involvement of Keystone personnel in the installation and maintenance of controls projects?

Who is on the clinker system project team?

<u>Existing Operations</u>
In your existing operation, what expectations do you have of maintenance [production] **workers?**

Are they meeting those expectations?

What skills do they have? What level of competence do they have?

What skills are production workers lacking?

Do the maintenance [production] workers serve the entire operation or a particular area? Do they have broad skills or a particular area of expertise?

Can well

What happens when there is a maintenance problem? What process occurs? What kind of formal or informal procedures are followed?

What skills are maintenance workers lacking?

Do problem areas exist? Why? Why can't work be done adequately? What is getting in the way?

Are troubleshooting skills an issue?

What skill areas do you perceive require more training? For production workers? For maintenance workers?

Do you perceive there may be a need for basic skills training? (Probe potential need for training in basic math skills, measurement, blueprint reading, industrial electricity....)

Is it your perception that your priorities for maintenance personnel are the same as those of maintenance supervisors and the maintenance personnel themselves?

If they differ, why do you think that is?

New Clinker Storage System
Are there barriers to the acceptance of the clinker storage system? Amongst supervisors? Amongst hourly personnel?

(cont) What is the current understanding of controls? By supervisors? By hourly personnel?

Does the union fully support all aspects of the clinker storage systems project? What is the union response to personnel acquiring new skills for new job responsibilities?

With implementation of the clinker storage system, how will job responsibilities/tasks of maintenance [production] personnel change? What new skills/understandings will be required?

How would you gauge personnel response to automation and technology? Your own own response? What is your perception of the response by other maintenance and production supervisors? What is your perception of the response by hourly personnel. Probe fears.

Are there barriers to training amongst Keystone personnel? Amongst supervisory personnel? Amongst hourly employees? What is the management philosophy regarding training of salaried and hourly employees?

What are the union issues relative to training? Is the union supportive of training? Are there guidelines/restrictions we should be aware of? Length of training? Who gets trained? Incentive systems?

What kinds of training have supervisory personnel been involved in in the past? Formal? Informal? On-site? Off-site?

What kinds of training have maintenance personnel been involved in in the past? Formal? Informal? On-site? Off-site?

What type of training support do you think Keystone will require to implement this and other automation projects? For maintenance personnel? For supervisors? On-site? Off-site? On-hours? Off-hours? Scope of recommendation. (Probe here interest in basic skills training.)

What type of additional technical support will be required to implement this and other automation projects?

keyques2/1/lotus 17

Maintenance Personnel

Introductions - name, position

NCC/CBI background information
Keystone needs assessment/training
Purpose of meeting/interview
Structure of interview
Tape record interview

Interview

Describe the primary function of the maintenance group at Keystone. Identify individual roles/responsibilities.

<u>New Clinker Storage System</u>
The clinker storage system is being installed at Keystone to decrease costs, increase quality, and increase plant utilization. The system is the first phase of a multi-phase project to automate cement production at Keystone. Automation will involve installation of control components requiring maintenance. These components may be unfamiliar to you.

Are you familiar with PLCs? Application, capabilities, operation, programming?

<u>EXISTING TECHNICAL SKILLS</u>
Certain prerequisite skills and understandings are necessary to benefit from PLC training.

In order to develop training programs to specifically address your needs, we need to have a better understanding of your existing responsibilities, your skill level, and that of your peers.

We are assessing skills of electrical maintenance personnel and will ask you your perception of the training needs of the group as a whole --not your individual needs -- to maximize impact of PLC training and maintenance and operation of clinker storage system.

What do you perceive to be the understanding of _____ by maintenance staff?

USE DESCRIPTIVE SHEET HERE

Control components? Sensors, actuators, processors, motors, reading basic control circuit diagrams? Pneumatic, hydraulic, and electrical controls? Numbering systems--binary and hexadecimal?

Industrial electricity? Electrical power, wiring & control? DC and AC generators and motors, transformers, electrical distribution, ground fault, overcurrent protection, industrial wiring methods and codes, and the proper use of meters in the high voltage setting?

Motor Controls? Installation, operation & troubleshooting of various types of motor controls? Motor starting methods, control pilot devices, diagram interpretation, basic control circuits, AC reduced voltage starters, 3-phase, multispeed, DC controllers and methods of deceleration?

Basic electricity I? Fundamentals of electricity, electrical safety, basic switching circuits, meter usage, basics of Ohm's Law, Watt's Law and simple series and parallel circuits?

Basic electricity II? Color code, DC and AC theory, Ohm's Law and Watt's Law in resistive series/parallel combination circuits, magnetism, inductance, electromagnetism and capacitance? Soldering?

Basic electronics? DC and AC operation of industrial electronic circuits. Basic applications of resistive, capacitive and inductive networks. Electromagnetic induction, reactance and resonance. Analysis of circuits using Ohm's Law (review) and Kirchoff's Law. Operation of RLC circuits.

Advanced electronics? Broad understanding of direct and alternating current circuits and components. The fundamentals of solid state devices such as transistors, diodes, rectifiers, SCR's triacs, FETs, and unijunctions, their biasing and circuit applications. Topics in digital electronics including binary numbers, gates, combinations of gates to form logical functions, and digital integrated circuits.

PROBLEM SOLVING SKILLS

What expectations are made of you on your job?

Who calls you, lets you know when there's a maintenance problem?

Who do you depend upon for specific information concerning a problem?

What is the sequence of events in solving a problem?

How about analyzing a problem? What is the sequence of steps you utilize?

What kind of assistance do you get in solving a problem?

Who provides the most assistance?

Do you often utilize a print or schematic to analyze the problem?

Are prints and schematics readily available?

What kinds of problems are typical?

Do they tend more often to be technical problems or basic maintenance problems?

How often are problems of a system nature as opposed to a specific problem?

What is the range of a typical shutdown of an operation for solving a maintenance problem?

Do you have ideas for what could be done to shorten that time period?

Who makes the decision on what repairs are to be implemented?

How often is it a maintenance person?

How often is it management/supervisors?

What role does management play in the solution of maintenance problems?

What about engineering?

What about operators?

How often do you call in "outside experts" to solve a problem?

Are you satisfied with the typical sequence of events in solving maintenance problems and the resolutions of those problems?

Is there anything that could be done to improve the process?

What changes would you like to see implemented?

TRAINING ISSUES

What most worries you about the installation of the new system?

Automation scares some people for a number of reasons? Do you perceive that to be the case at Keystone? Why?

Have you ever been involved in learning additional skills?

As a part of your job or on your own?

What kind of emphasis on training and gaining additional skills is there within Keystone?

Why do you think this is?

Are there additional skills necessary for advancement?

What stops people from gaining additional skills?

In developing a plan for a comprehensive training program, there are several important issues we need to consider.

One of these is trainees' basic skills level. Sometimes when we set up a particular skill training program, people don't have the necessary math and/or reading skills to be successful in the training. It can be even more of a factor when people have been away from school a long time.

What degree of a problem might exist?

What are the most significant needs?

If we were to set up a comprehensive training program for maintenance

workers, what do you think would be the response?

What level of interest and participation would we find?

What would motivate people to participate in such a training program?

What obstacles would you see?

What else should we know about the needs of maintenance workers?

What else should we consider as we're developing the plan for a training program?

Production Personnel

Introductions - name, position

NCC/CBI background information
Keystone needs assessment/training
Purpose of meeting/interview
Structure of interview
Tape record interview

Interview

Describe the primary function of the production personnel at Keystone. Identify individual roles/responsibilities.

<u>New Clinker Storage System</u>
The clinker storage system is being installed at Keystone to decrease costs, increase quality, and increase plant utilization. The system is the first phase of a multi-phase project to automate cement production at Keystone. Automation will involve installation of control components requiring maintenance. These components may be unfamiliar to you.

How do you think installation of the clinker storage system will impact your job / your day-to-day responsibilities?

Are you familiar with control components? PLCs? Motor controls? Sensors?

What do you perceive to be the skill level/understanding of controls by production [maintenance] **staff?**

What new skills/understanding will be required?

What most worries you about the installation of the new system?

Automation scares some people for a number of reasons? Do you perceive that to be the case at Keystone? Why?

In order to develop training programs to specifically address your needs, we need to have a better understanding of your existing responsibilities, your skill level, and that of your peers.

Existing Operations -- Operator Skill

What level of skills do typical production workers have?

Is their skill level adequate?

What other skills are required?

Is that clearly recognised?

Maintenance personnel will be required to troubleshoot and maintain controls. They will participate in greatest amounts of training. We need your assistance in assessing their skills.

Existing Operations -- Maintenance Skill

What do you do when there's a maintenance problem? Who do you call?

What kinds of problems are typical?

Do you get the right kind of assistance to get the problems solved?

Who makes the decision to implement particular response actions?

Who do you depend upon for specific information concerning a problem?

What is the sequence of events in getting assistance?

How quickly and efficiently do the problems get resolved?

How often is there a shutdown of an operation due to a maintenance problem?

Do you feel that there is an adequate response system?

How could it be improved?

From your perception is there an adequate maintenance staff?

Do they have the necessary skills to do the job?

What role do you as an operator play in solving maintenance problems:

Should you have a different kind of role/involvement?

Are you satisfied with the typical sequence of events in solving maintenance problems and the resolutions of those problems?

Proposed Training

Have you ever been involved in learning additional skills?

As a part of your job or on your own?

What kind of emphasis on training and gaining additional skills is there within Keystone?

Why do you think this is?

Are there additional skills necessary for advancement?

.hat stops people from gaining additional skills?

In developing a plan for a comprehensive training program, there are several important issues we need to consider.

)ne of these is trainees' basic skills level. Sometimes when we set up particular skill training program, people don't have the necessary ath and/or reading skills to be successful in the training. It can be ven more of a factor when people have been away from school a long ime.

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.nat are the most significant needs?

If we were to set up a comprehensive training program for production nd maintenance workers, what do you think would be the response?

.hat level of interest and participation would we find?

What would motivate people to participate in such a training program?

What obstacles would you see?

TARKETT, INC
NEEDS ASSESSMENT

Topic: Controls Training for Electrical Maintenance Personnel

TARKETT SKILLS SURVEY

In the first column, please indicate your level of familiarity with each topic listed. In the second column, please indicate your department's level of familiarity with each topic listed.

1 = excellent understanding
2 = average understanding, review would be helpful
3 = no understanding

	Your Level of Understanding			Your Department's Level of Understanding		
[MATH. REVIEW]						
1. Simple equations	1	2	3	1	2	3
2. Calculations (+,-,x,/, sq rt., & cube root)	1	2	3	1	2	3
3. Fractions	1	2	3	1	2	3
4. Decimals	1	2	3	1	2	3
5. Percents	1	2	3	1	2	3
[COMPUTER LITERACY]						
6. Basic operation, DOS commands & directories	1	2	3	1	2	3
[BASIC ELECTRICITY I]						
7. Fundamentals of electricity	1	2	3	1	2	3
8. Electrical safety	1	2	3	1	2	3
9. Basic switching circuits	1	2	3	1	2	3
10. Meter usage	1	2	3	1	2	3
11. Ohm's law	1	2	3	1	2	3
12. Watt's law	1	2	3	1	2	3
13. Simple series circuits	1	2	3	1	2	3
14. Simple parallel circuits	1	2	3	1	2	3
[BASIC ELECTRICITY II]						
15. Color code	1	2	3	1	2	3
16. DC and AC theory	1	2	3	1	2	3

17. Resistive series/ parallel circuits	1	2	3	1	2	3
18. Magnetism	1	2	3	1	2	3
19. Inductance	1	2	3	1	2	3
20. Electromagnetism	1	2	3	1	2	3
21. Capacitance	1	2	3	1	2	3
22. Soldering	1	2	3	1	2	3
[INDUSTRIAL ELECTRICITY]						
23. Electrical power, wiring, & control	1	2	3	1	2	3
24. Meter usage in high voltage settings	1	2	3	1	2	3
25. Overcurrent protection	1	2	3	1	2	3
26. DC and AC generators & motors	1	2	3	1	2	3
27. Transformers	1	2	3	1	2	3
28. Relays & contactors	1	2	3	1	2	3
29. Electrical distribution	1	2	3	1	2	3
30. Ground fault	1	2	3	1	2	3
31. Industrial wiring methods & codes	1	2	3	1	2	3
32. Interpreting industrial electrical symbols & line diagrams (US & German)	1	2	3	1	2	3
[INDUSTRIAL NEC CODE]	1	2	3	1	2	3
[MOTOR CONTROLS]						
33. Installation, operation, & troubleshooting of motor controls	1	2	3	1	2	3
34. Motor starting methods	1	2	3	1	2	3
35. Solenoids used for motor control	1	2	3	1	2	3
36. Diagram interpretation	1	2	3	1	2	3
37. Basic control circuits	1	2	3	1	2	3

38. 3-Phase, multispeed controllers	1	2	3	1	2	3
39. Control devices at Tarkett	1	2	3	1	2	3
40. Reversing circuits	1	2	3	1	2	3
41. AC reduced voltage starters	1	2	3	1	2	3
42. Accelerating and decelerating methods & circuits	1	2	3	1	2	3
43. Applied DC systems at Tarkett	1	2	3	1	2	3
44. Preventative maintenance & troubleshooting of motor controls	1	2	3	1	2	3
[BASIC CONTROL CONCEPTS]						
45. Control components (i.e. control valves, flow meters, & pressure switches)	1	2	3	1	2	3
46. Sensors (i.e. switches, capacitive/inductive sensors)	1	2	3	1	2	3
47. Actuators -- Electric	1	2	3	1	2	3
48. Actuators -- Hydraulic	1	2	3	1	2	3
49. Actuators -- Pneumatic	1	2	3	1	2	3
50. Processors (i.e. microprocessors, mini-computers, single board computers)	1	2	3	1	2	3
51. Reading control circuit diagrams	1	2	3	1	2	3
52. Pneumatic control symbols	1	2	3	1	2	3
53. Hydraulic control symbols	1	2	3	1	2	3
54. Electrical control symbols	1	2	3	1	2	3
55. Numbering systems (binary & hexadecimal)	1	2	3	1	2	3
56. Flow charts	1	2	3	1	2	3

[BLUEPRINT READING REVIEW]

57. Reading & troubleshooting schematic diagrams	1	2	3	1	2	3
58. Reading & troubleshooting single line diagrams?	1	2	3	1	2	3
59. Reading & troubleshooting Reliance Electric drawings	1	2	3	1	2	3
60. Reading & troubleshooting foreign drawings i.e. Siemens	1	2	3	1	2	3

[ELECTRONICS]

61. DC and AC operation of industrial electronic circuits	1	2	3	1	2	3
62. Resistive, capacitive, & inductive network applications	1	2	3	1	2	3
63. DC & AC circuits/components	1	2	3	1	2	3
64. Solid state devices, their biasing & circuit applications	1	2	3	1	2	3
65. Gates, combinations of gates to form logical functions, & digital integrated circuits	1	2	3	1	2	3

[PROGRAMMABLE LOGIC CONTROLLERS]

66. Programmable logic controllers. Capabilities, operation, & troubleshooting	1	2	3	1	2	3
67. Reading PLC ladder diagrams--General	1	2	3	1	2	3
68. Reading PLC ladder diagrams--Allen Bradley	1	2	3	1	2	3
69. Reading PLC ladder diagrams--Siemens	1	2	3	1	2	3
SIMPLE PLC PROGRAMMING (NO/NC coils, latches)						
70. With handheld programmer?	1	2	3	1	2	3
71. W/Allen Bradley PC software?	1	2	3	1	2	3
72. W/Siemens PC software?	1	2	3	1	2	3
73. W/other PC software (which one)? _____	1	2	3	1	2	3

ADVANCED PROGRAMMING CONCEPTS

74. Using timers	A-B	1	2	3	1	2	3
75. Using timers	Siemens	1	2	3	1	2	3
76. Using counters	A-B	1	2	3	1	2	3
77. Using counters	Siemens	1	2	3	1	2	3
78. Using sequencers	A-B	1	2	3	1	2	3
79. Using sequencers	Siemens	1	2	3	1	2	3
80. Using program flow control	A-B	1	2	3	1	2	3
81. "	Siemens	1	2	3	1	2	3
82. Accepting thumbnail input		1	2	3	1	2	3
83. Writing to displays		1	2	3	1	2	3
84. Memory address manipulations		1	2	3	1	2	3
85. Relational operators		1	2	3	1	2	3

Tarkett Interview Questions

Describe the primary function of the maintenance group at Tarkett. Identify individual roles/responsibilities.

PROBLEM SOLVING SKILLS

What expectations are made of you on your job?

Who calls you, lets you know when there's a maintenance problem?

What is the sequence of events in solving a problem?

How about analyzing a problem? What is the sequence of events you utilize?

What kind of assistance do you get in solving a problem?

Do you often utilize a print or schematic in solving a problem?

What kinds of problems are typical?

Do they tend more often to be technical problems or basic maintenance problems?

How often are problems of a system nature as opposed to a specific nature?

What is the range of a typical shutdown of an operation for solving a maintenance problem?

Do you have ideas for what could be done to shorten that time period?

Who makes the decision on what repairs are to be implemented?

What role do the following play in the solution of maintenance problems--

Management?

Engineering?

Operators?

How often do you call in outside experts to solve a problem?

Are you satisfied with the typical sequence of events in solving maintenance problems and the resolution of those problems?

Is there anything that could be done to improve the process?

What changes would you recommend?

TRAINING ISSUES

Technology scares some people for a number of reasons? Do you perceive that to be the case at Tarkett?

Have you ever been involved in learning additional skills? On the job or on your own?

What kind of emphasis on training and gaining additional skills is there at Tarkett?

Why do you think this is?

What skills are necessary for advancement?

What stops people from getting additional skills?

In developing a plan for a comprehensive training program, there are several important issues we need to consider.

One of these is trainees' basic skills level. Sometimes when we set up a particular skill training program, people don't have the necessary

math and/or reading skills to be successful in the training. It can be even more of a factor when people have been away from school a long time?

What degree of a problem do you think exists?

What are the most significant needs?

If NCC was to set up a comprehensive training program on controls, what do you think would be the response?

What level of interest and participation would we find?

What would motivate people to participate?

What obstacles would you see?

What else should we consider as we're developing the plan for a training program?

tark/1/51

DENT MANUFACTURING NEEDS ASSESSMENT

Topic: Math. for Machine Tool Operators

Assessment for Machine Technology

Part I

DENT MATH ASSESSMENT

1. Express the fractions in each of the following sets as equivalent fractions having the least common denominator.

a. $\frac{1}{4} \cdot \frac{3}{16} \cdot \frac{9}{32}$ _____ b. $\frac{7}{16} \cdot \frac{5}{32} \cdot \frac{9}{64}$ _____ c. $\frac{7}{10} \cdot \frac{3}{4} \cdot \frac{9}{25} \cdot \frac{13}{20}$ _____

2. Add or subtract each of the following values. Express the answers in lowest terms.

a. $\frac{1}{8} + \frac{5}{8}$ _____

c. $\frac{5}{8} + \frac{13}{32}$ _____

f. $\frac{11}{16} - \frac{7}{16}$ _____

g. $\frac{17}{20} - \frac{3}{5}$ _____

3. Multiply or divide each of the following values. Express the answers in lowest terms.

b. $\frac{3}{4} \times \frac{4}{5} \times \frac{2}{3}$ _____

e. $\frac{3}{16} \times 20 \times 5\frac{1}{2}$ _____

h. $\frac{14}{15} \div \frac{7}{25}$ _____

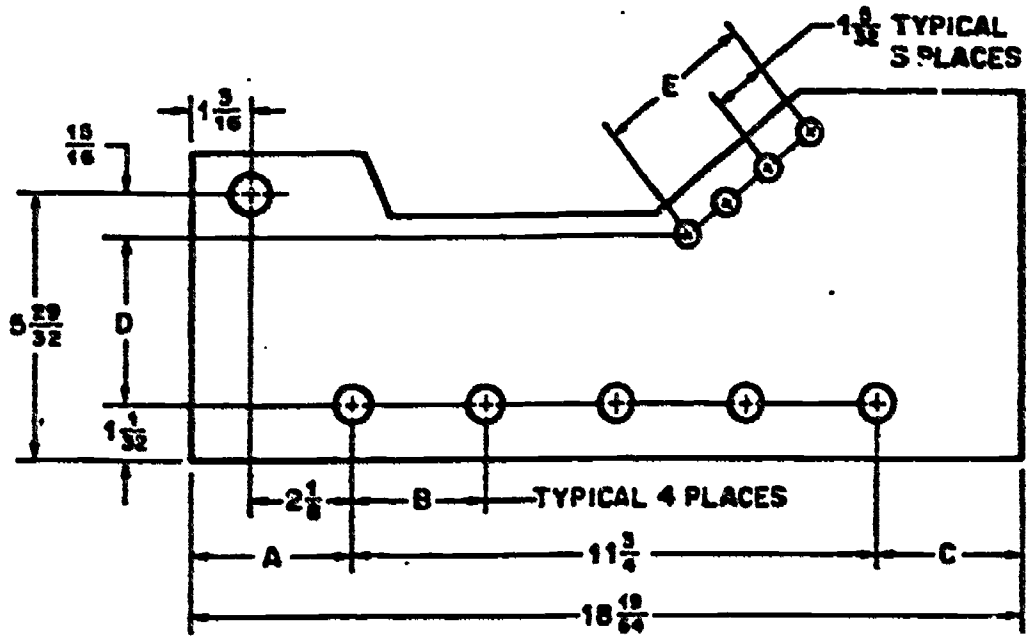
i. $2\frac{17}{32} \div \frac{9}{24}$ _____

4. How many complete pieces can be blanked from a strip of aluminum 72 inches long if each stamping requires 1 3/8 inches of material plus an allowance of 3/4 inch at one end of the strip? _____

(2)

5. Compute dimensions A, B, C, D, and E of the support bracket shown. All dimensions are given in inches.

A = _____
B = _____
C = _____
D = _____
E = _____



6. Express each of the following common fractions as decimal fractions. Where necessary, round the answers to 3 decimal places.

d. $\frac{2}{25}$ _____ e. $\frac{13}{20}$ _____

7. Express each of the following decimal fractions as common fractions in lowest terms.

b. 0.525 _____ e. 0.0075 _____

8. Add or subtract each of the following values.

c. 0.006 + 12.3 + 0.0009 _____

e. 23 + 0.0007 + 0.007 + 0.4 _____

g. 0.1863 – 0.0419 _____

i. 0.009 – 0.0068 _____

9. Multiply or divide each of the following values. Round the answer to 4 decimal places where necessary.

b. 3.63×2.30 _____ f. $0.85 \div 0.39$ _____

d. 0.005×0.180 _____ g. $0.0098 \div 5.036$ _____

10. Raise each of the following values to the indicated powers.

b. 0.50^3 _____ d. $\left(\frac{3}{5}\right)^2$ _____

11. Determine the whole number roots of each of the following values as indicated.

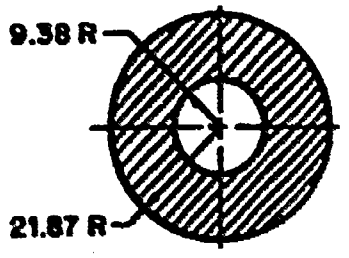
b. $\sqrt[3]{64}$ _____ c. $\sqrt{\frac{36}{81}}$ _____ e. $\sqrt{39.2 \times 1.25}$ _____

12. A shaft is turned in a lathe at 120 revolutions per minute. The cutting tool advances 0.030 inch per revolution. How long is the length of cut along the shaft at the end of 3.5 minutes? _____

Solve the following problems. Use $\pi = 3.14$. Round answers to 2 decimal places.

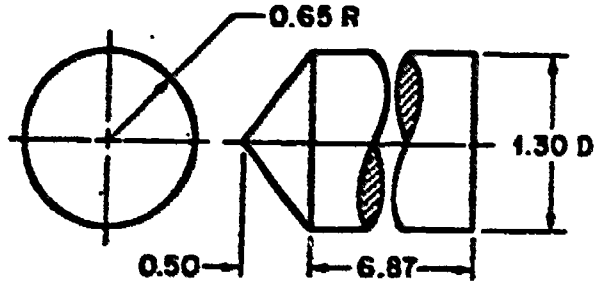
13. Find the metal area of this washer. All dimensions are in millimeters. _____

$A = \pi \times R^2$



14 A. Find the volume of this pin. All dimensions are in inches. _____

Volume of cylinder = $\pi \times R^2 \times H$
Volume of cone = $0.2618 \times D^2 \times H$



B. If steel weighs 0.283 #/in^3, How much does the pin weigh? _____

15 For each measurement find

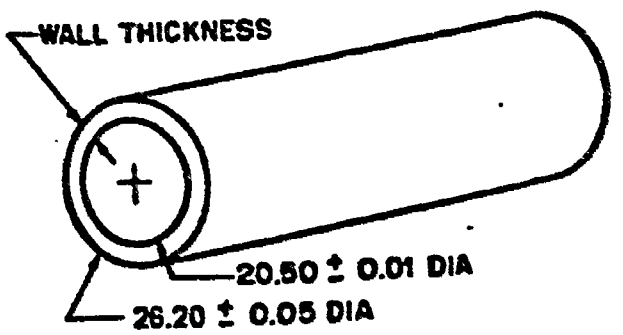
a. the degree of precision.
b. the value which is equal to or less than the range of values.
c. the value which is greater than the range of values.

1. 4.3"	a. _____	b. _____	c. _____
2. 1.62"	a. _____	b. _____	c. _____
5. 15.885"	a. _____	b. _____	c. _____

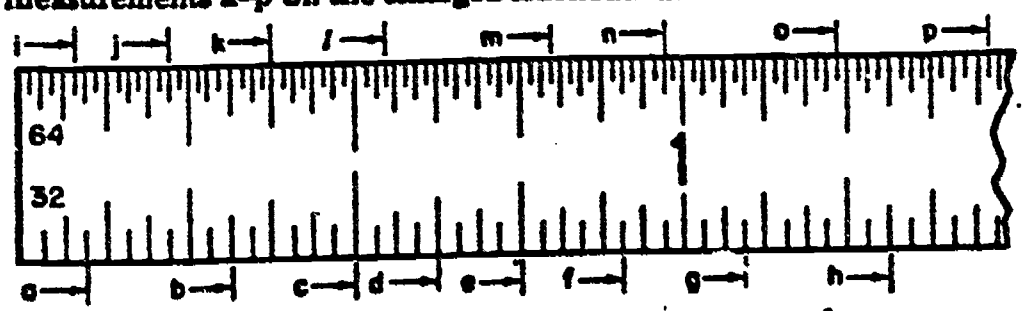
16. Determine the maximum and minimum permissible wall thickness of the steel sleeve shown. All dimensions are in millimeters.

maximum _____

minimum _____



17. Read measurements a–p on the enlarged fractional-inch rule shown.

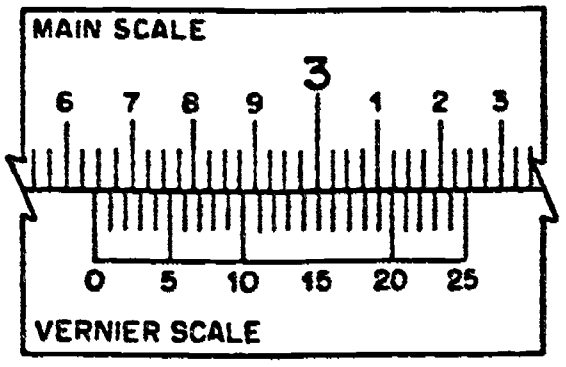


a. _____ b. _____ c. _____ d. _____ e. _____ f. _____ g. _____ h. _____

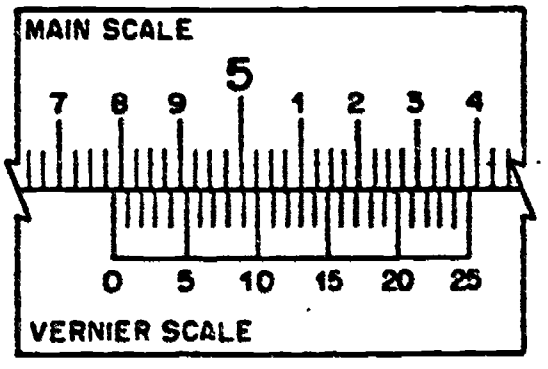
i. _____ j. _____ k. _____ l. _____ m. _____ n. _____ o. _____ p. _____

18. Read the decimal-inch vernier caliper measurements for the following settings.

a. _____



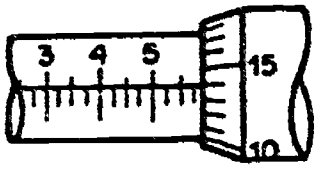
e. _____



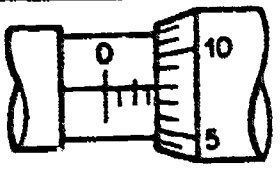
19. 0.001-Inch Micrometer

Read the settings on the following 0.001-inch micrometer scales.

1. _____



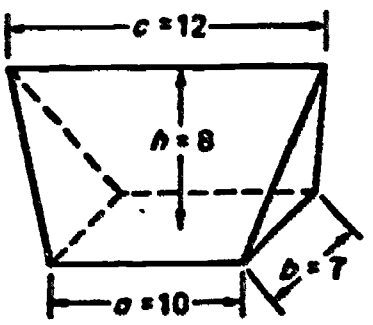
4. _____



Hint: Be Sure To Describe it as a 1" max. micrometer

20. **All dimensions are in inches.**
Find the volume.
Volume $= \frac{(2a + c)bh}{6}$

_____



21. **Substitute the given numbers for letters and find the value for each of the following expressions.**

a. Find $(5a + 6b) \div 4b$ when $a = 4$ and $b = 5$. _____

b. Find $3xy - (2x + y)$ when $x = 6$ and $y = 3$. _____

22. **Solve for the unknown in each of the following equations using one of the six principles of equality. Check each answer.**

a. $x + 12 = 33$ _____

e. $14.3 = x + 53.6$ _____

m. $s^2 = 81$ _____

p. $\sqrt[3]{V} = 5$ _____

23. **In each of the following formulas, substitute given numerical values for letter values and solve for the unknown and check. Calculate answers to 3 decimal places where necessary.**

d. $c = \sqrt{a^2 + b^2}$. Solve for b when $a = 8.000$ and $c = 10.000$. _____

24 Rearrange each of the following formulas in terms of the designated letter.

c. $M = D - 1.5155P + 3W$. Solve for W. _____

f. $HP = \frac{D^2N}{2.5}$. Solve for D. _____

$V = \frac{\pi D^2}{4} H$ Solve for D _____

25 Analyze each of the following problems to determine whether the problem is a direct or inverse proportion and solve.

a. A reamer tapers 0.0975 inch along a 3.2625-inch length. What is the amount of taper along a 2.1250-inch length? _____

b. A machine produces 2550 parts in 8.5 hours. How many parts are produced by the machine in 10 hours? _____

c. Of two gears that mesh, one gear with 12 teeth revolves at 420 rpm. What is the revolutions per minute of the other gear which has 16 teeth? _____

26 Solve the following cutting speed and gear problems.

A steel shaft 2.300 inches in diameter is turned in a lathe at 250 rpm. Determine the cutting speed to the nearer whole number. _____

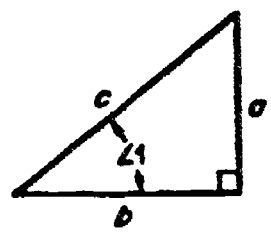
$$C = \frac{3.1416DN}{12}$$

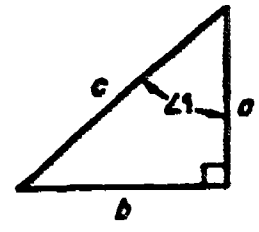
27. Express 68.85° as degrees and minutes. _____

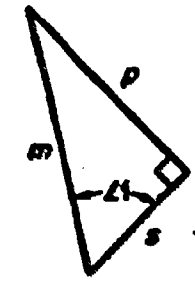
28 Express 37°23′ as decimal degrees to 2 decimal places. _____

29 With reference to ∠1, name the sides of each of the following triangles as opposite, adjacent, or hypotenuse.

a. _____ b. _____ c. _____ d. _____







30 Determine the functions of the following angles.

a. sin 22° _____

d. tan 0°21′ _____

e. cos 63°18′ _____

f. tan 14°24′ _____

31 Determine the values of ∠A in decimal-degrees to 2 decimal places that correspond to the following functions.

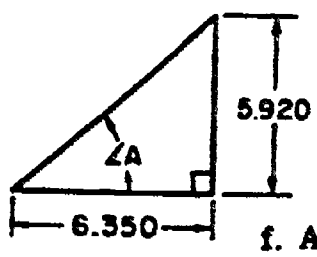
a. sin A = 0.72847 _____

b. tan A = 1.3925 _____

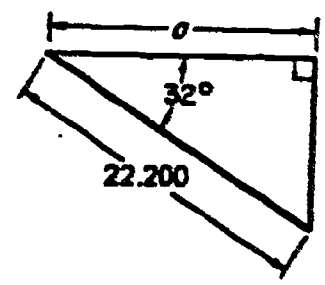
c. cos A = 0.340 38 _____

32 Solve the following problems. Compute angles to the nearer minute in triangles with English unit sides. Compute angles to the nearer hundredth degree in triangles with metric unit sides. Compute sides to 3 decimal places.

a. Determine ∠A. All dimensions are in inches. _____



b. Determine side a. All dimensions are in inches. _____

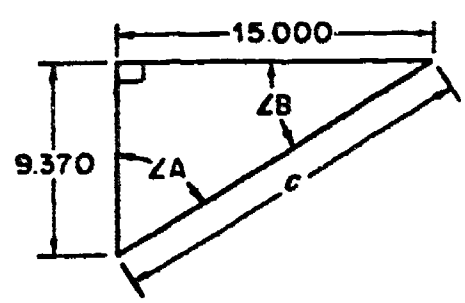


f. All dimensions are in inches.

(1) Determine ∠A. _____

(2) Determine ∠B. _____

(3) Determine side c. _____



(9)

Refer to the points plotted on the illustrated Cartesian Coordinate plane. Write the x and y coordinates of the following points, A–M.

A = _____ H = _____

B = _____ I = _____

C = _____ J = _____

D = _____ K = _____

E = _____ L = _____

F = _____ M = _____

G = _____